AUTO G130: ENGINE PERFORMANCE: BASIC THEORY/DIAGNOSIS

Item	Value
Curriculum Committee Approval Date	11/16/2021
Top Code	094800 - Automotive Technology
Units	4.5 Total Units
Hours	117 Total Hours (Lecture Hours 63; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

This course is an introduction to the theory, knowledge, and skills necessary to understand engine performance concepts. Instruction is given and lab experience provided which will enable students to successfully perform diagnostics and repair on engine management and related systems. Information presented is based on the Automotive Service Excellence (ASE) Engine Performance Tasks and Standards intended to prepare students for the ASE A-8 Engine Performance certification examination. ADVISORY: AUTO G110 and AUTO G120. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Diagnose automotive engine performance and emission systems and related circuits.
3. Use diagnostic tools and equipment used for automotive engine performance and emission repairs.
4. Interpret basic engine performance concerns through fundamental measurements and diagnosis.

Course Objectives

- 1. Pass all assigned safety tests and certifications.
- 2. Interpret wiring diagrams, schematics, and electrical power flow on engine performance control circuits.
- 3. Perform systematic analysis on electronic engine management systems and circuits using industry-accepted testing procedures, and diagnostic tools and equipment.
- 4. Perform related electrical measurements and compare against factory specifications.

Lecture Content

Safety Basic auto technology shop safety instruction and demonstrations. Electrical fundamentals and basic test equipment. Current flow in electrical circuits. AC vs. DC voltage concepts. Ohms law: Computing voltage, current, and resistance values. Electro-mechanical concepts. AC / DC theory and diode rectification concepts. Voltage values and voltage drop concepts. Electrical malfunctions: Shorts, grounds, opens, and high resistance issues. Key-off battery parasitic drain. Basic diagnostics used on engine management circuits. Voltmeters, Ammeters, Ohmmeters. Test lights, multimeters, logic probes. Theory and concepts of engine operation. Basic engine construction and operation. Computing torque, work, power, and horsepower. Air pressurizing (compression), combustion, theory and concepts. Computer control of engine management systems. Fundamentals of control modules. Input sensors. Engine coolant temperature. Intake air temperature. Manifold ablsolute pressure. Barometric pressure. Throttle position. Oxygen. Air Fuel ratio. Mass air flow sensors. Output actuators. Basic ignition system concepts. Science of combustion: igniting the air-fuel mixture. Concepts of magnetic induction: high secondary voltage for the spark plugs. Timing the spark. Analysis of ignition waveform. Engine fuels and combustion. Gasoline. Science of petroleum processing. Ratings and additives. Testing fuel for contaminants and quality. Combustion concepts and theory. Other fuels. Diesel, bio-diesel. Ethanol, methanol and hydrogen. E85 mixed fuels. Basic electronic fuel-injection concepts. Throttle body injection. Port fuel injection. Gasoline DIrect Fuel Injection. Controlling the air/fuel mixture. Idle air controls and Electronic Throttle Control. Controlling excessive exhaust and other fuel-related emissions. Science of smog. Ozone from sunlight, NOX and VOCs. Equipment and other contributors to smog. Mechanical emission control devices: theory and concepts of operation. PCV (Positive Crankcase Ventilation). Secondary Air injection. Evaporative Emission Control System (EVAP). Exhaust gas recirculating system (EGR). Catalytic converters. Science of electronics to control exhaust and other emissions. On-board Diagnostics (OBD) I and OBD II systems overview. Diagnostics task management. Monitors and enabling criteria. Analysis and diagnostics of engine mechanical condition. Testing and measuring against factory specifications to determine engine condition. Engine absolute (vacuum/boost) manifold pressure. Cylinder compression. Cylinder leakage. Cylinder power balance tests. Exhaust back pressure testing. Engine performance diagnosis and testing. Retrieval and interpretation of service and repair information. Identification and interpretation of engine performance concerns. Retrieval of on board diagnostic (OBD) I and OBD II codes. Diagnosis using scan tools to analyze diagnostic trouble codes (DTCs). Inspec tion and testing of ignition system pick-up sensor or trigger devices. Retrieval and recording of stored OBD II trouble codes and data. Analysis of inspection and testing results of inputs to body control module (BCM) and Power train module. Analysis of emissions vs. driveability. Power train control module (PCM) system analysis using a graphing multimeter (GMM), a digital storage oscilloscope (DSO).

Lab Content

General Engine Diagnosis Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. Identify and interpret engine performance concern; determine necessary action. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins. Locate and interpret vehicle and major component identification numbers. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. Diagnose abnormal engine noise or vibration concerns; determine necessary action. Diagnose abnormal exhaust color, odor, and sound; determine necessary action. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. Perform cylinder power balance test; determine necessary action. Perform cylinder cranking and running compression tests; determine necessary action. Perform cylinder leakage

test; determine necessary action. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action. Verify engine operating temperature; determine necessary action. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action. Verify correct camshaft timing. Computerized Engine Controls Diagnosis and Repair Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable. Diagnose the causes of emiss ions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action. Check for module communication (including CAN/BUS systems) errors using a scan tool. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action. Access and use service information to perform step-by-step diagnosis. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action. Perform active tests of actuators using a scan tool; determine necessary action. Describe the importance of running all OBDII monitors for repair verification. Ignition System Diagnosis and Repair Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. Inspect and test ignition primary and secondary circuit wiring and solid state components; test ignition coil(s); perform necessary action. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, e ngine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action. Check fuel for contaminants and quality; determine necessary action. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. Inspect and replace fuel filters. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. Inspect and test fuel injectors. Verify idle control operation. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action. Perform exhaust system back-pressure test; determine necessary action. Test the operation of turbocharger/supercharger systems; determine necessary action. Emissions Control Systems Diagnosis and Repair Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. Inspect, test and service positive crankcase ventilation (PCV) filter/ breather cap, valve, tubes, orifices, and hoses; perform necessary action. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action. Inspect and test mechanical components of secondar y air injection systems; perform necessary action. Inspect monitor criteria and drive cycle for continuous and trip monitors. Inspect and test catalytic converter efficiency. Diagnose emissions and driveability concerns caused by the evaporative emissions control system. Computer Networking Inspecting Control Area Network (CAN). Determine normal, shorted or open CAN system operation. Inspect and test CAN systems using Digital Multi Meter (DMM). Inspect and test basic CAN system functions using digital Storage Oscilloscope (DSO).

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Reading Assignments

Textbook reading assignments

Writing Assignments

1. Create vehicle repair orders, perform math exercises for flat rate labor, parts, and materials totals.2. Demonstrate an understanding of engine performance concepts by solving related mathematical problems.3 Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment.4. Use web-based service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostic activities.

Out-of-class Assignments

Textbook assignments Interactive web based training

Demonstration of Critical Thinking

1. Analyze and troubleshoot electrical circuits which support engine operation and restore them to proper service.2. Analyze, confirm, and diagnose engine performance-related faults based on symptoms indicated on repair orders.3. Relate diagnostic test results directly to circuit or component failures based on readings or measurements.4. Analyze wiring diagrams to determine integrity of circuits which support engine operation.

Required Writing, Problem Solving, Skills Demonstration

1. Create vehicle repair orders, perform math exercises for flat rate labor, parts, and materials totals.2. Demonstrate an understanding of engine performance concepts by solving related mathematical problems.3 Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment.4. Use web-based service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostic activities.

Eligible Disciplines

Automotive technology: Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required James Halderman. Advanced Engine Performance Diagnosis, 7th ed. Pearson, 2020